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13 July 1984

USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT

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MACHINE TOOLS AND METALWORKING EQUIPMENT

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INDUSTRY MINISTER ON NEED FOR ADVANCED MACHINE TOOLS

Moscow PRAVDA in Russian 27 Mar 84 p 6

[Interview with B.V. Bal'mont, USSR minister of the machine tool and tool building industry, by a PRAVDA correspondent: "Robot and Laser for the Machine Tool"; date and place not specified]

[Text] An international exhibition of equipment, apparatus and instruments for the metalworking industry--"Metalloobrabotka-84"--opened today at the Moscow exhibition complexes on Krasnaya Presna and the Sokolniki Park. A PRAVDA correspondent asked B.V. Bal'mont, USSR minister of the machine tool and tool building industry and chairman of the exhibition's organizing committee, to tell us about this exhibition.

Machine tool building is a key sector in machine building, the minister said. Progress in metalworking determines improvements in efficiency in machine tool building and exerts a marked effect on the quality and volumes of equipment produced for all sectors of the economy; and it is of decisive influence in labor productivity and the economic use of materials and energy. The exhibition that is now on is enabling Soviet and foreign specialists to familiarize themselves with the latest world achievements in the field of metalworking.

There is no doubt that "Metalloobrabotka-84" is exerting a favorable effect on the expansion of scientific and technical and commercial links between states.

[Question] How is Soviet machine tool building being shown at the exhibition?

[Answer] The Soviet section is the most inspiring in the exhibition. It is providing an opportunity to get acquainted with the present-day technical level of this sector of industry. I have in mind first and foremost the switch to the extensive production of NC metalworking equipment. This is made up primarily of multiple-operation machine tools with automatic changing of instruments--the so-called machining centers. Automatic, rapid-adjustment lines fully covering all production processes are now being developed on increasing scales. Machine tools are being produced that can be set up as sets with automatic computer-controlled sections and flexible production systems. One example of this is the "Talka-500" system at the Ivanovo Machine Tool Building Association, and another is the automatic adjustable line at the Moscow Stankoagregat Plant.

In the group of equipment for lathe operations we are showing an improved modification from a new generation of turning lathes from the Moscow Krasnyy proletariy Plant, equipped with a storage device for machining parts and an industrial robot used to fit them or remove them from the lathe. This kind of equipment is fitted with microprocessor devices with online and long-term storage.

The technological section on cold pressing of parts, based on presses rated at 63,000 tons, a "three-armed" industrial robot and a magazine device is of great interest.

The Soviet section contains about 500 exhibits, and each of them is interesting.

[Question] Which foreign countries are taking part in the exhibition?

[Answer] Organizations and firms from six of the CEMA countries, Yugoslavia, and 14 capitalist states, including Austria, Great Britain, the United States, France, the FRG, Switzerland and Japan. More than 500 organizations and firms are showing their products.

Soviet machine tool builders support close contacts with enterprises and organizations in the CEMA countries. For example, together with specialists from the GDR a heavy "maching center" that has no counterpart anywhere in the world has been developed. A model of it is to be shown at an exhibition in the GDR. And in the Soviet section there is a revolving-turning "machining center" in whose development the Czechoslovak firm "Kovosvit" participated directly.

[Question] Could you please characterize the exhibits from other participants?

[Answer] The capitalist firms are showing highly automated NC machine tools, presses and installations, including those using lasers. Equipment is designed mainly for machining parts for machines in small-series runs with restricted use of servicing personnel. Machine tools designed for incorporation in flexible, automated production systems are widely represented. The stands for the French, FRG and Japanese firms have industrial robots for loading and unloading operations and assembly work in machine tool building, and the latest control and measuring systems.

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UPDATE ON MODERNIZATION OF MACHINE TOOL BUILDING SECTOR

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 28 Apr 84 p 1

[Editorial: "Effectiveness in Reconstruction"]

[Text] Enterprise reconstruction and retooling is an important direction in the development and consolidation of our economy. It is the shortest and most economical way to improve efficiency in social production and increase the return from capital investments. It makes it possible to achieve considerable output growth with less expenditures, compared with new construction.

In his speech to electors, CPSU Central Committee general secretary comrade K.U. Chernenko said: "It is absolutely essential for us to insure rapid and constant renewal of all sectors in the national economy on the basis of the modern achievements of science and technology. This is one of our most important tasks."

During the third year of the five-year plan hundreds of plants and factories have undergone reconstruction, thousands of new machines, machine tools, units, and production lines have been installed, and the use of microprocessors and robot technology has expanded. As a result, working conditions have been improved and labor productivity has been raised.

Special attention has also been paid in the 1984 plan and budget to the primary allocation of resources for the reconstruction and retooling of existing enterprises. The experience of collectives in Moscow, Leningrad, Sverdlovsk, Ivanovo and Kemerovo oblasts shows the kind of major reserves that can be brought into play if reconstruction and renewal of enterprises is done in a planned and continuing way.

In order to produce stainless steel pipes at the Pervomaysk New Pipe Plant it was originally intended to construct a new shop at a cost of R20 million. But plant specialists, in cooperation with the scientists, proposed another way--creating a new production facility through reconstruction of one of the two shops. They spent R1 million to do this.

Three-fourths of capital investments at enterprises in Leningrad are allocated for modernization and renewal. These funds are recouped on average twice

as quickly as when similar capacities are created through new construction. Each percentage point of increase in labor productivity at renewed enterprises is twice as cheap than at new enterprises.

At the same time, retooling of many plants and factories is often done too slowly, equipment lies for long periods in the warehouses and becomes obsolescent, and the return from invested funds is low. The following also happens: instead of replacing old equipment with more mordern equipment, new boxlike structures are built alongside large existing buildings, costing a great deal. This far from businesslike approach to production development does not always receive a principled appraisal from the local party committees and ministries and administrations. Moreover they sometimes themselves assume an incorrect position.

The forging and pressing shop at the Zhdanov Heavy Machine Association was long in need of reconstruction. But instead of setting about renewing the shop the Ministry of Heavy and Transport Machine Building gave orders for the construction of a new shop. Construction was slow--about 5 years--and still, after all that, the project was canceled. Some R3.5 million of assets are now frozen.

Everyone knows how important it is, already in the planning stage to define the goals of reconstrction and its final economic results. In practice, however, this is by no means always done. We often encounter the following: the production facility is renewed but, as before, obsolete articles come rolling off the conveyer belt, or capacities are poorly used.

As the result of reconstruction of the Kabbalpromstroy Trust Nalchik House-Building Combine capacities were increased from 35,000 square meters of housing annually to 120,000 square meters. However, for more than a year only half this capacity has been used. It is impossible to be reconciled with such cases. The party organizations are called upon to make the proper evaluation and enhance the responsibility of management personnel for this direction of growth. Practice shows that close cooperation between party and soviet organs and the ministries and administrations helps toward success in this matter. It enables deeper study of the opportunities available to each collective and the determination of a general strategy of actions.

When starting reconstruction it is essential to plan the course of the work with care, pay special attention to comprehensive mechanization and automation, and take into account the latest achievements of science and practice. Only then will production renewal yield the desired result: increasing output and improving its quality, and improving working conditions.

In connection with the new approach to reconstruction and retooling of enterprises, the USSR Gosstroy and the State Committee for Labor and Social Problems face major tasks. They are called upon to analyze the state of affairs carefully, insure economic interest on the part of the construction collectives in reconstruction, draw up clear instructions, and monitor the execution of these instructions. Here it is essential to take into account the fact that the contract construction subdivisons are not eager to do this

kind of work and that they place their resources at efforts for this at the bottom of their priority list. This is explained by the fact that reconstrcution is labor intensive while the volumes of work are small and, as they say, the weather never does anything to help plan fulfillment. Construction workers much prefer to build new plants.

The CPSU Central Committee Politburo recently considered the question of improving planning, organization and management in capital construction. The CPSU Central Committee and USSR Council of Ministers decree adopted on this question provides for a series of measures aimed in particular at accelerating retooling and reconstruction of enterprises.

One of the main tasks of the fourth year of the five-year plan and of the five-year plan as a whole is to direct the initiative of the collectives toward improving production and its reconstruction and to obtain the maximum return from every ruble invested in the development of enterprises and increase output with minimum expenditures.

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POOR PLANNING, WASTE OF EQUIPMENT AT URALMASH NOTED

Moscow PRAVDA in Russian 3 Apr 84 p 3

[Article by V. Danilov: "They Have Finally Unpacked Them -- Following Up Letters"]

[Text] Even a mere listing of these devices arouses curiosity: an OZhYe microsound unit, a raster-type electron microscope, a laser microanalyzer, a Kvantimet-720 television microscope. The story of their truly enormous potential for investigating the secrets of the structure and hardening of metals, alloys, and other materials is even more intriguing. One receives the report that the Uralmash Association is one of the few in the country to posses this unique set of contemporary metal physics equipment with respect for the initiative and foresight of the Uralmash managers. But after all, a big organizations does things in a big way.

But here is the surprise: it turns out that these very expensive pieces of equipment, which were purchased abroad, were not unpacked for 18 months. "And they are still standing idle today; there is no carefully prepared plan for using them," states a letter to PRAVDA from M. Kukhtin, Z. Boganova, V. Cheremnykh, and L. Odintsova, associates at the laboratory of heat-resistant steels of the division of metallurgical technology of the Uralmash Scientific Research Institute of Heavy Machine Building. "This is mismanagement."

It is true that the equipment is not in use. Why? V. Sinitskiy, deputy director of the institute, gives a detailed answer to this question. It was contemplated that the equipment would be housed in the building of the thermal shop, which was under construction. Unfortunately, it still has not been put into use today. A decision was adopted to prepare spaces meeting requirements in the division of metallurgical technology. But realization of the plans was greatly delayed, and not least of all by the lack of vigor, if not to say opposition, of former division chief, now a pensioner B. Titorov, and the very same group of associates who wrote the letter to PRAVDA. Now though, in the words of the deputy director, things are straightened out.

I will note, however, that the change for the better occurred precisely thanks to the authors of the letter. Before writing to PRAVDA they appealed to the USSR State Committee for Science and Technology. It formed a commission which studied the situation at the site and reported its conclusions to the Ministry of Heavy and Transport Machine Building. This was followed by an order from R. Arutyunov,

first deputy minister, outlining specific steps to eliminate the shortcomings that had been disclosed. The order speeded up the work.

So here they are, these intelligent and multitalented machines, in the just-repaired quarters. V. Farafonov, head of the laboratory of heat-resistant steels, remarks:

"As you see, things are fine, a great deal has been done. And the ones who are complaining are actually avoiding participation in preparation of the space."

Judging by everything, L. Tarasov, chief of the division of metallurgical technology, and V. Sokolov, his deputy, agree with V. Farafonov.

But this does not jibe with the letter of M. Kukhtin, Z. Boganova, and the others and their complaint to the State Committee. So still we have to wonder -- did they stand in the way or did they help? Let us try to clear things up.

The intelligent machines have already been unpacked. But they stand lifeless. Conditions for using them effectively will not appear until the next five-year plan. But there was an opportunity to cut the time loss greatly.

In May 1982 the administrators of the Ural Polytechnical Institute came to Uralmash with a proposal to set up a joint laboratory which would make it possible to increase the volume and raise the quality of research done by the Uralmash Institute and improve the training of specialists for the enterprise. And in view of Uralmash's difficulties, the institute offered available space in its buildings (the space met all requirements) and expressed its readiness to send highly skilled specialists to the laboratory. The managers of Uralmash rejected the proposal: such riches, they said, could not be given to anyone.

In vain the prorector of the institute tried to point out to the Uralmash people that the polytechnical institute was not asking that the equipment be turned over to them; they were simply willing to offer a place to house it. No agreement was forthcoming. The only ones unreservedly for the idea were the former head of the division of metallurgical technology B. Titorov and M. Kukhtin, Z. Boganova, and their comrades in the laboratory of heat-resistant steels. At one time they had prepared the documentation for purchase of the equipment, and they had studied and mastered the skills needed to use it; in short, they knew what it was worth. That is probably why they were upset at the lost time.

"It is too late," B. Titorov sighs. "As they say in such cases, the ship is already gone."

The authors of the letter do not conceal their fears today that the time losses will continue to multiply, that the ship will put in at some small harbor. Their statements were sometimes harsh in form, and accompanied by some unsound demands. This is, from the viewpoint of the Uralmash people, their "opposition to implementation of the plan." There is no question that harsh words in work disputes are no help. But the fears did not arise out of nothing.

Yes, the space was basically ready. There is a plan of joint research with the polytechnical institute and other organizations. On this basis the administrators of the research institute state that everything is more or less all right. But there are many different kinds of spaces, and plans too. And this space and this plan in no way inspire confidence as to the success of the work. The set of equipment, which is just right for the material base of a respectable scientific research center, remains in a small technological subdivision, the laboratory of heat-resistant steels. The scope of the problems it is being used for is not at all appropriate to the broad capabilities of the equipment.

"Uralmash needs the devices," V. Cheremnykh, on of the authors of the letter to PRAVDA, acknowledges, "but only for one-fifth of their varied capabilities."

Then what about the remaining 80 percent? And even this one-fifth is in question. The experimental brigade, which is able to operate the complex research devices, is being replaced with an untrained group. At the wish of laboratory head V. Farafonov the four authors of the letter are being gradually squeezed out of work with the equipment.

Why do the wishes and opinion of one person win out where the last word is supposed to belong to a collective of knowledgeable specialists? This question was raised by the authors of the letter to PRAVDA. After studying the circumstances of this protracted story the answer suggest itself: the opinion of one individual is winning out because the administrators of the research institute and the managers of the association find it more convenient that way. It is less trouble for them. V. Farafonov has taken on the main efforts of housing the equipment and operating it, and that is fine with them. A difficult problem appears to be solved.

It is a strange situation. The idea of shared use of scientific equipment by research establishments of different departments is steadily gaining force in the country. Stocks of collective-use equipment and regional subdivisions for centralized research service are being set up. But in this case they are going in the other direction: unique equipment is kept idle, but they do not want to enter into cooperative use. Is this a far-sighted posture for Uralmash, whose collective is noted for innovation and its orientation to the future?

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USSR-HUNGARIAN COOPERATION IN MACHINE TOOLS DEVELOPMENT

Moscow EKONOMICHESKOYE SOTRUDNICHESTVO STRAN-CHLENOV SEV in Russian No 2, Feb 84 pp 6-8

[Article by Andrash Gabor, deputy minister of industry, Hungarian People's Republic: "Participation of the HPR in International Specialization and Cooperation in Machine Building Production"]

[Text] One of the most important and decisive spheres of economic cooperation of the CEMA member states is specialization and cooperation in production.

SPECIALIZATION is the concentration of production of uniform products in one or several countries for the purpose of satisfying the demands of the other interested countries for these products.

COOPERATION is joint activity based on specialization of production of the corresponding parts, units and assemblies of the end product of certain phases of the technological process.

There are two known types of international specialization of production: intersectorial and intrasectorial.

The purpose of specialization of production in machine building is the output of modern products in rational series and in correspondence with the quantitative and qualitative demands of the domestic and world market by means of eliminating parallelism and concentrating the production of these products in no more than three countries. The following measures are used to achieve this end in the HPR:

a selective policy of developing industry. For example, increasing the output of buses, medical instruments, communications technology, stopping production of trucks, dump cars, tractors, motorized loaders, railroad cargo cars, etc.;

selection of the spheres of specialization which make it possible to economically and rationally utilize fixed capital;

import of products from sectors requiring great capital investments (mining, road construction, casting equipment);

organization of specialized production and export of products which are successfully sold in foreign markets, with consideration of the portion of imports from capitalist countries for their production (buses, motorized trains, medical instruments, etc.);

comprehensive consideration of consumer demand in selecting the products subject to specialization;

creating conditions for specialization which correspond with the interests of the national economy (direction of capital investments, development of progressive technology).

Let us analyze the condition and problems of specialization and cooperation of production in Hungary's machine building.

By 1983 the HPR had concluded 129 agreements for bilateral and 84 agreements for multilateral specialization in machine building. According to these, deliveries in the sum of 1,330,000,000 rubles were made in 1982. Their portion in the overall volume of exports of machine building production in our country comprised 46.2 percent. Sixty-eight percent of all the machines and equipment exported from the HPR is directed to the USSR alone.

Deliveries of specialized production by Hungarian machine building in 1982 by groups of products comprised (million rubles):

Metal cutting machine tools	22.4
Power and electrotechnical equipment	25.5
Lifting-transport equipment	58.1
Transport means	744.0
Tractors and agricultural machines	33.3
Instruments, bearings, tools, outfitting	76.6

Before the implementation of the reform in the cost accounting mechanism for managing the Hungarian national economy (1968), the conclusion of agreements on specialization and cooperation was performed as the result of the corresponding decisions by the country's central departmental organs. In the absence of any material interest, the enterprises had no stimulus for implementing technical progress, ensuring full utilization of production capacities, and developing specialization and cooperation.

With the introduction of the new system of management, work on specialization and cooperation of production is associated primarily with the interests of the enterprises, which themselves decide the degree of their participation in this process. The system of managing the economy is based on the interest of the enterprises in achieving maximal profit. The incentive for participation of enterprises in specialization and cooperation of production is provided by means of systems of material involvement, regulation of income, and a system of price formation associated with the latter. We are striving toward the situation whereby the portion of profit realized in the price will more fully reflect the actual effectiveness of various productions (i.e., so that the enterprises whose work is most economically effective for the national economy will receive the greatest income).

husbandry). According to this agreement, tractors, combines, and machines for tobacco farming are imported.

By agreement on specialization in production of machines and equipment for the food industry, the HPR supplies primarily machines and equipment for the poultry processing, meat and canning industries, and packing machines. It imports machines for the sugar, brewing and leather industries.

In the high-voltage power industry, the HPR specializes in the manufacture of special technological equipment, primarily machines for cable production. According to six agreements on multilateral specialization in the machine tool building industry, the HPR has taken on the responsibility of supplying 62 models, including traditional metal cutting machine tools as well as machine tools with ChPU [numerical control].

By specialization in transport machine building, the HPR participates in 10 agreements, in which it provides 30 percent of its domestic trade turnover. Of the finished products, we export coupled buses, out of 27 titles of assemblies, units and parts there are rear axles, servotabs, diesel engines, and also 26 products which are part of the nomenclature for specialization of production for garage technology and technical servicing equipment.

At present, only bilateral agreements have been concluded on the production of passenger automobiles. We believe it would be expedient to look into the possibility of developing multilateral agreements.

Over 10 percent of the HPR exports are sold within the framework of agreements on multilateral specialization in the production of vessels for marine and inland waterways navigation. We supply vessels for inland waterway navigation and floating cranes.

Great significance is given in our country to agreements on specialization in the production of railroad cargo and passenger cars, cargo and refrigerated trucks, as well as motor vehicles for communal farming. According to these agreements, the HPR supplies the demands for them instead of ineffective domestic production.

Almost seven percent of the country's domestic trade turnover is realized through 14 agreements concluded in the electronics industry. Among the products which we export we may name semiconductor devices, integrated circuits, and computer technology products.

For purposes of fulfilling the tasks set forth in the DTsPS [Long-term Target Program of Cooperation] on machine building, as well as the resolutions of the CEMA Session (34th and 35th meetings) on meeting the demands of the CEMA member states for modern machines and equipment, the efforts of the HPR are being concentrated on increasing the effectiveness of production, developing modern technologies, reducing the expenditure of materials and energy in product output, improving the technical level and quality of products, and finally, reducing the import of machines and equipment from capitalist countries.

From the moment of the economic reform, aside from the specialized domestic trade organizations (MOGYuRT [expansion unknown], "Transelektro", "Metrimpeks", etc.), the major production enterprises in machine building (MVG [expansion unknown], "Telefonnyy zavog" [telephone plant], "Medikor", "Gants-Mavag", etc.) have the right to establish international economic ties.

The development of specialization and cooperation in production at our country's enterprises operating under conditions of the new mechanism must be facilitated primarily by their interest in attaining income, in satisfying the demands of the market in the socialist countries, as well as in tying in the interests of enterprises with those of the national economy.

Specialization of production in machine building is being implemented in a planned manner, and agreements on specialization are prepared and concluded just as methodically. Enterprises which have an interest in the output as well as in the consumption of specialized products participate in this work.

However, we must mention the problems present in the practice of work on specialization, which hinder its planned preparation. In particular, this refers to the long time (1-2 years) needed for compilation of product nomenclature for specialized items within a framework of multilateral agreements, and the conclusion of agreements on specialization without preliminary determination of specific prices. This leads to so-called forced specialization of industrial enterprises stemming from their production capacities.

The peculiarities of the HPR economy, which is to a large degree oriented toward export, as well as the capacity of the domestic market and the volumes of machine building production determine Hungary's interest in specialization and cooperation in production between the CEMA member states. Export of machine building production has great significance for the HPR for covering the imports from the fraternal countries, including those power carriers and raw materials, as well as finished products, assemblies and parts necessary for the HPR national economy.

The machine building plants of Hungary are readily participating in the manufacture of products within the framework of agreements on specialization and cooperation.

The advantages of specialization and cooperation are confirmed by the fact that the greatest number of agreements on multilateral specialization of production have been concluded in machine building. Of 10,000 products covered by specialization agreements, the HPR has interests in approximately 1,800.

The greatest number of agreements on multilateral specialization has been concluded in the sectors of general machine building. In 1971-1980 their portion in the overall volume of exports comprised 52 percent, and of imports -- 72 percent. Thus, according to the agreement on specialization of tractor and agricultural machinery production, 25 percent of the deliveries are realized through multilateral specialization. Hungarian machine building enterprises specialize in the production and delivery of 63 products (cleaning machines and accessories for them, machines for fruit and vegetable farming and animal

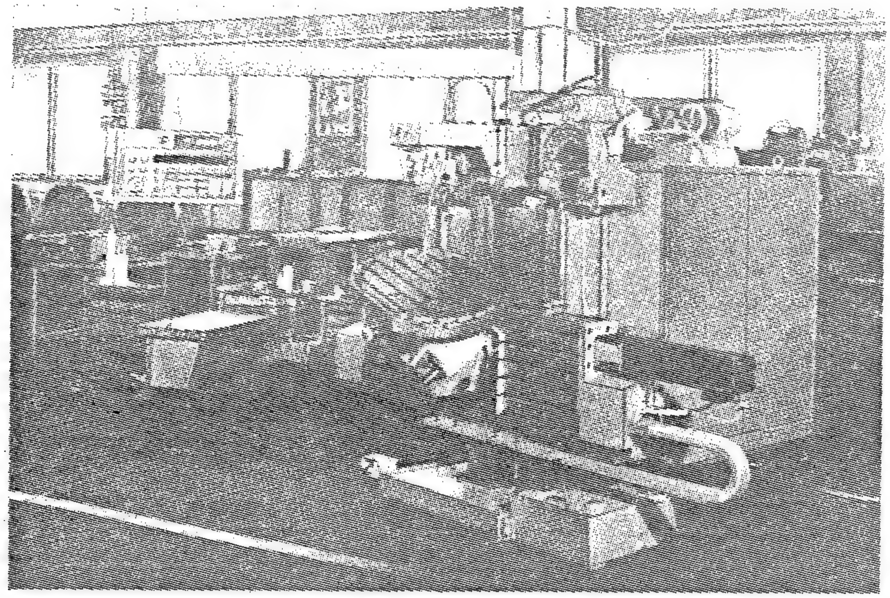

Figure 1. NC Milling Machine

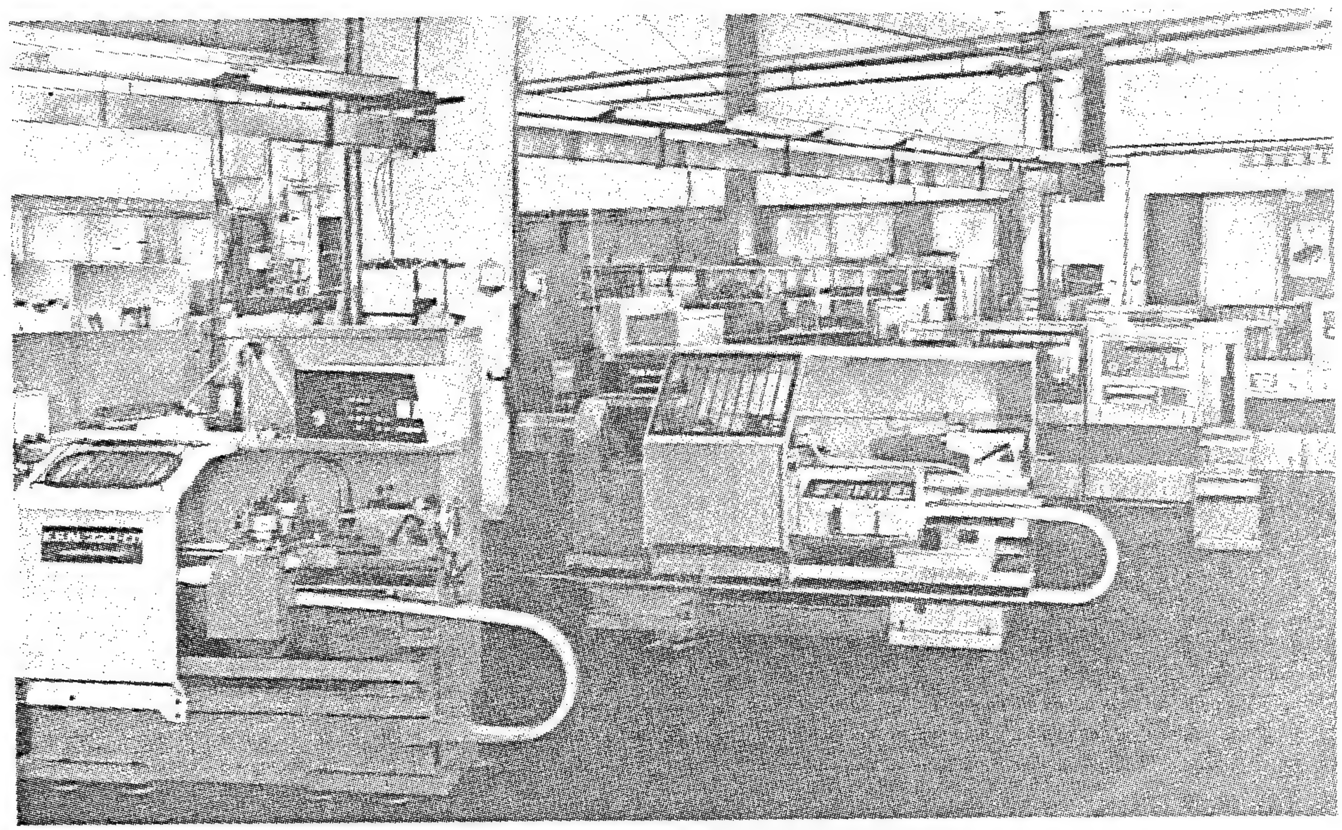

Figure 2. NC Lathe

The participation of the HPR in international specialization and cooperation ensures the development of modern machine building in the HPR which presents a reliable base for the development of the national economy capable of quickly reacting to changes in foreign trade.

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LASER-HARDENING OF ALUMINUM ENGINE PARTS DESCRIBED

Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 2, Feb 84
pp 50-52

[Article by A. G. Grigor'yants, doctor of technical sciences, A. N. Safonov, candidate of technical sciences, N. A. Makusheva and V. M. Tarasenko, engineers, "Laser Hardening of Parts Surfaces of Internal Combustion Engines"]

[Text] It is advisable to laser-harden parts of internal combustion engines when it is necessary to treat sections of local surfaces of relatively large parts in hard to reach places. Moreover, the good hardening qualities of most materials used in engine building, makes it possible to pose the comprehensive problem of increasing the strengthen of the entire unit and, therefore, of the whole engine. Of great importance is increasing the service life of the piston-sleeve unit. The possibility of hardening aluminum piston alloys of the Al-Si (AL25, AL26, AL30, AKM7 etc.) system by laser radiation was checked by treating samples of these alloys with a gas laser (LT1-2 device, continuous mode, with CO_2 as the active medium). The treatment modes were varied within the following limits: radiation power -- 0.5 to 4 kw, speed -- 16.3 m/min. When treating with such modes, surface fusing was observed.

The microhardness of the hardness of aluminum alloys after laser treatment is shown below

	Microhardness H_{20}, kg-force/mm^2
AL4	97-179
AL9	95-122
AL10V	257-122
AK5M7	257-146
AL25	146-265
AL26	301-179

As shown by the above data, the microhardness of casting and forging aluminum alloys whose composition is near the eutectic one, increases 1.5 to 2.0 times when laser treated with fusion. A metallographic and x-ray analysis indicated that hardening is due to a considerable reduction in the structure and oversaturation of the hard alloy. Aluminum alloys of the Al-Si system do not harden without fusing.

The hardening method for compression channels of pistons is being developed in two directions.

First, the side surfaces of a finished channel are hardened, for which purpose the laser beam is directed at them at an angle of about 30°. With a radiation power of 1.5 kw and a treatment speed of 13 m/min, roughness tolerance limits are maintained. However, the hardening zone is small with the width being 1.7 to 2 mm and the depth 0.12 to 0.14 mm. An increase in the depth of the zone to 1.4-1.8 mm was achieved with a radiation power of 2 kw and treatment speed of 0.2-0.4 m/min; however, in this case the channel was produced with a tolerance of 0.1 mm for the following machining, since there was a considerable increase in the surface roughness, due to fusing.

Secondly, laser fusing is done on intermediate products of pistons with the following cutting of channels. Fusing is done by a 2 to 4 kw radiation with a sharply focused beam in two passes with a treatment speed of 0.3 to 0.6 m/min and a defocused beam for one pass. The microhardness of the zones was found to be 146 to 245 kg-force/mm^2. When treating with a focused beam, pores are formed in the fusing zone; therefore, it is preferable to treat the intermediate product with a defocused beam. The dimensions of the hardened zone are: width 4.7-7.5 mm, depth 1.12-2.75 mm.

The hardened piston unit requires compression piston rings made of gray cast iron, alloyed, as a rule, with chromium, nickel and molybdenum (initial microhardness H_{50}=317 to 340 kg-force/mm^2). The surface of the rings was treated on the "Kvant-16" LT1-2 and SP-973 laser devices of the "Spektra fiziks" firm (see Table) according to three arrangements (see Fig.)

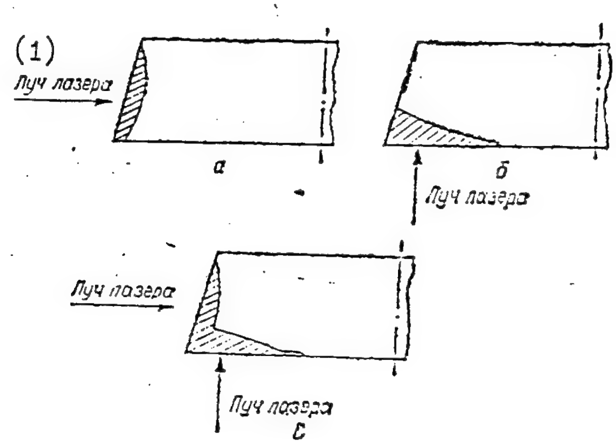

Fig. Arrangement of laser hardening of compression rings: 1 -- Laser beam

The measurement of the properties of the hardened rings indicated that in laser treatment, swelling in the radial direction of up to 0.02 mm (tolerance 0.02 mm) is possible. It is, therefore, necessary to take into account the increase in ring dimensions. It is most advisable to do the treatment according to arrangement c.

Test stand tests of rings after hardening by "Kvant-16" and LT-2 devices did not detect essential improvement in strength (apparently, due to the shallow depth of the layer). Rings hardened on device SP-973 have an 0.1-0,2 mm depth of hardened zone and pass test stand tests successfully. The treatment of sleeves by the CO_2 laser with 1.5 kw radiation power and a speed of 0.9 m/min makes it possible to obtain hardened strips 0.57 mm deep and 4.6 mm wide without fusing the surface.

Table

Hardening efficiency without fusing surface

Parameter of hardened zone	"Kvant-16"	LT1-2	SP-973
Depth, micrometer	10-40	20	200-275
Width, micrometer	-	340	1000-1800
Microhardness			
H_{50}, kg/force/mm^2	532	-	450-530

Hardening the valve unit of the internal combusiong engine is of great importance. A method was developed for gas-powder laser hard-facing of the edge chamfer of the valves by chrome-nickelalloys. The hard-facing is done bu feeding the powder filling into the treatment zone at a radiation power of 2 to 3 kw and a treatment speed of 0.1 to 0.2 m/min. The height of the hard-facing layer is o.7 to 0.8 mm which is considerably less than in other hard-facing methods.

The seat of the valves made of gray cast iron was hardened on the SP-973 device (radiation power 1 kw, speed of treatment 6 m/min, diameter of spot 4mm). The possibility in principle of laser hardening of valve bushings made of alloyed gray cast iron has been proven. In treating bushings, the laser beam was directed at an angle of 30° at the internal surface. The treatment of radiation power of 1 kw, treatment speed of about 1.5 m/min and the spot diameter of 1 mm made it possible to obtain a hardened zone about 0.6 mm deep and 2.3 mm wide with a fused surface. The microhardness increased from H_{50}=380-420 initially to 500-840 after treatment.

Thus, the practice of the development and introduction of laser technology indicates that the process of laser thermal hardening make it possible to increase the service life of individual parts and the entire engine, and increase its power.

2291
CSO: 1823/239

UDC 621.9.048.7

PRACTICAL APPLICATION OF KVANT-16 LASER DESCRIBED

Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 2, Feb 84 pp 46-47

[Article by V. S. Kovalenko, doctor of technical sciences, V. P. Dyatel, candidate of technical sciences, "Laser Treatment of Holes in Curved Pipes"]

[Text] To improve the technological process of machining small diameter holes in curved pipes with a wall thickness of 1 mm (Kh18N10T steel) it is proposed to use laser radiation. A preliminarily modernized series produced "Kvant-16" laser device is used for this purpose. The spherical resonator of the basic device was replaced by a flat one, while the charge-discharge feed of the of the pumping tube was replaced so that the radiation pulse does not exceed 1 millisecond. This provides a reduction in the divergence of and an increase in the radiation power density localized in the treatment zone. To visualize the focusing zone (the treatment zone) and reduce the labor-intensiveness of adjusting the optical components of the laser device, a type LG-78 gas laser is installed in its rear part on a special bracket coaxially with the optical axis of the oscillator. Its radiation is combined with the optical axis of the oscillator and is focused into a visible point of red color which is the focus of the lens.

The treated part is based along two prisms 6 (see Fig.) regulated in the vertical direction. To increase the basing accuracy, the prisms are made 2 mm wide with a distance of 10 to 15 mm between them. Part 5 is fixed by tightening it by the lower support 8, hinge-connected to the rod of pneumatic cylinder 7, engaged by the operator by pressing a foot pedal.

In a modernized laser device, protection from the incandescent metal particles ejected from the treatment zone is provided for the lens. For this purpose protective membrane 9, wound on feeding cassette 1 is located in front of lens 2 that focuses laser radiation 4. After each radiation pulse, a signal is sent from the power unit of the laser oscillator to the drive of the receiving cassette 3. As a result, the receiving cassette turns and the protective membrane, moves its contaminated part from under the lens. The membrane moves 15 to 20 mm after each pulse.

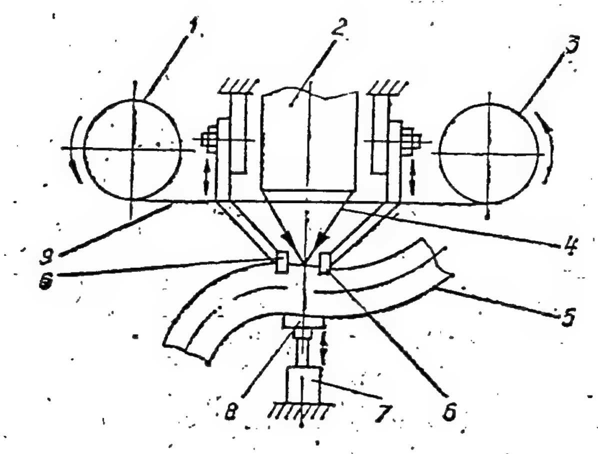

Fig. Arrangement for basing the treated part

The holes are made as follows. When the laser device is cut in, the gas laser begins to operate. The operator, holding the pipe on whose surface the axes of the holes to be made are preliminarily marked, sets it in line with the upper prisms. Since the gas laser at this moment is cut in; the operator sees a red dot on the surface of the pipe. The pipe is oriented so that the marked axis of the treated hole coincides with the visible red dot. Then the operator presses the foot pedal to control the pneumatic cylinder whose rod moves out and the lower flat support forces the pipe against the upper prisms, insuring its fixation in the oriented position. The laser oscillator is switched on and the hole is treated by a certain number of pulses. After the hole is treated, the operator switches off the oscillator and disconnects the pneumatic cylinder. The bottom support is lowered by several millimeters, the pipe is loosened, remaining in the fixture, and the operator orients the pipe for treating the next hole.

The holes are made in the folowing modes: pulse energy -- 20 to 25 joules; focal distance of lens -- 70 mm; number of pulses directed to the treatment zone -- 2 to 4; pulse frequency -- 0.75 to 1 Hz. The diameter of the treated holes is 0.6 to 1 mm; the treatment depth is 0.5 to 2 mm; the time is 4 to 8 seconds. The dimensional characteristics of the treated holes are changed by varying the radiation energy, the number of pulses and the location of the treated surface with respect to the focal point of the lens.

The use of laser radiation to make holes in curvilinear pipes makes it possible to eliminate drilling, countersinking (with laser treatment the holes have a conical inlet) and to remove burrs from the inner part of the surface of the pipe. This reduces the production cost per hole and reduces the use of manual labor.

2291
CSO: 1823/238

POORLY DESIGNED PRESS ANGERS BELORUSSIAN CUSTOMERS

Moscow PRAVDA in Russian 17 Apr 84 p 2

[Unattributed report: "A Million.... in the Warehouse"]

[Text] A letter from L. Il'yutchik, leader of a comprehensive brigade at the Pinsk Forging and Pressing Automatic Line Plant, published under the above title (PRAVDA 11 Jan 84) dealt with a KA-0430 press made by the enterprise to produce articles made from metal powders, that is now sitting in a warehouse. The ministry that ordered the equipment was in no hurry to collect it.

N. Rosh, secretary of the Belorussian Communist Party Pinsk Gorkom, has reported to the editorial office that L. Il'yutchik's letter was examined by the gorkom buro. It was acknowledged that the matters raised in the letter objectively reflect the state of affairs existing at the plant. The party gorkom buro obliged the party organization at the plant to improve the initiative and political activeness of communists and all members of the collective and to strive for further strengthening of executive and labor discipline and improvements in economic activity.

Responses were received by PRAVDA from four ministries, namely of the radio industry, the electrical equipment industry, the communications equipment industry and the electronics industry. In the responses it is acknowledged that there have been cases of refusals by individual enterprises to accept models of the KA-0430. This was because of changes in the production program, products lists and technological processes and nondelivery of metal powders and their poor quality. Steps have been taken to distribute the finished presses.

At the same time, it is pointed out in the responses that during operation of the KA-0430 presses design defects and a poor quality of fabrication were found.

The Minstry of the Machine Tool and Tool Building Industry, within whose purview the Pinsk Forging and Pressing Plant Line Plant is, has taken steps making it possible to market the automatic presses; this is discussed in the response of the deputy minister A. Vasil'yev. Planning has been improved and the marketing section strengthened in order to avoid similar situations at the plant in the future. The USSR Gosplan and the the USSR Gossnab Main Administration for Machine Tools and Instruments have amended the actual 1984 requirements for the KA-0430 automatic presses.

9642
CSO: 1823/258

INDUSTRY MINISTER ON FMS, ROBOTICS

Moscow TRUD in Russian 31 Mar 84 p 2

[Article by M. Shkabardnya, minister of instrument making, automation equipment, and control systems of USSR: "Manage Effectively: People and Machines: NOT [Scientific Organization of Labor] and Retooling are the Path of Production Intensification"]

[Excerpts] There is a well-known truth that success depends above all on the organization of a matter. I would emphasize scientific organization in particular. This concerns the brigade, the plant and the sector. Production intensification is impossible without an improvement in management, a bettering of labor organization, and retooling. The Extraordinary February CPSU CC Plenum emphasized with new vigor the importance of intensification, the accelerated adoption of the achievements of science and technology in production, and the implementation of major, comprehensive programs for raising society's productive forces to a qualitatively new level.

The results of work for three years of the Five-Year Plan show that enterprises are fulfilling established quotas successfully. During this time more than 200 fully mechanized shops and sections, some 500 mechanized flow-conveyor, semiautomatic and automatic lines, almost 900 machine tools with numerical program control (ChPU), and more than 7,000 robots, manipulators and robot engineering complexes have been adopted.

But despite the intensive adoption of mechanization and automation equipment, some 35 percent of workers in the sector still are engaged in manual labor. These are above all fitters on machine assembly jobs and warehousemen and loaders at nonmechanized warehouses. The output of these workers naturally is lower than in those operations using machines and mechanisms. The implementation of a comprehensive program will allow a reduction in the proportion of manual jobs in the sector to 32.5 percent already in this year. The rates of mechanization and automation of manual operations will rise considerably in the future.

Of course this involves the resolution of many difficult problems, and here is one of them. There are shops where everything is done by automatic machines

and the people merely observe their work. Such systems are effective in mass and large-series productions, but this automated equipment is unprofitable for instrument making enterprises where small-series production is typical. It is also unprofitable because of the high cost and lengthy planning of new kinds of products and placing them in production. But the primary deficiency of automated industrial equipment with rigid control programs is the impossibility of their rapid, easy readjustment for putting out new articles.

That is how the idea of developing a flexible automated production (GAP) arose. Versatile, rapidly readjustable equipment controlled by a special program was developed. The basis of GAP comprises the machine tools and machines with ChPU, industrial robots and manipulators, and control devices based on EVM's [electronic computers].

Practically all industrial, ancillary and transport operations are automated in flexible productions. Let's take machine processing for example, where the working of parts under a given program, the change of cutting tools, monitoring of parts after as well as during the working process, chip removal, and transporting parts from tool to tool in any sequence can be automated. Control over the work of the entire equipment complex also is automated.

This year the first flexible automated productions will begin operation in the sector and in the middle of the next five-year plan we will complete the automation of industrial processes in all basic subunits at two Moscow timepiece plants.

Scientific organization of labor demands more effective use of any equipment. As a matter of fact it costs the country very much to have costly, highly productive equipment standing idle or to have it operate on one shift. According to data of 24-hour observation performed by USSR TsSU [Central Statistical Administration] on 19 May 1983, the shift work coefficient of metal working equipment at sector enterprises was 1.47 in the primary production. This is of course insufficient. We plan to take it to 1.53 already in the current year. An acceleration of the rates of retooling, and the automation and mechanization of manual jobs and ancillary production processes will contribute to a further improvement in the shift coefficient.

Accelerated adoption of standard plans for labor organization at work places, sections, shops and enterprises is of great importance in improving the shift coefficient. Two-shift work is envisaged as one of the mandatory conditions in drawing up these plans. Certification of work places for conformity to standard plans also is a necessary condition. Already today more than 64 percent of work places correspond to standard plans of labor organization.

Another problem--attainment of planned labor-intensiveness--also is closely connected with this one. If the work place is outfitted according to the last word of science and technology and if labor organization meets modern requirements, then it is possible not only to reduce labor-intensiveness to the planned level, but even cut it still more. Initially, however, we have to determine this important parameter for each article.

Design and technological organizations of the sector are doing this. They are determining the scope, sequence and time periods for performing jobs and personal responsibility for developing planned and normative labor-intensiveness, and subsequently they will monitor its attainment.

All this permits an annual reduction in labor-intensiveness of manufactured articles by seven percent for the sector as a whole. Today we have achieved the standards of planned labor-intensiveness in producing more than a thousand new articles, but this is of course not enough. The adoption of robotized lines, industrial robot complexes and manipulators, and an improvement in the standardization level of articles being put in production will contribute to a further advance along this path.

This year sector workers decided to raise labor productivity an additional one percent above the plan and reduce production cost another 0.5 percent.

6904
CSO: 1823/263

ROBOT-INTEGRATED CNC TURNING CENTER MODULE DESCRIBED

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 2, Feb 84 26-28

[Article by Doctor of Technical Sciences R. I. Silin, Candidates of Technical Sciences V. P. Koshel' and Ya. F. Stadnik, and Engineers V. I. Kazmirchuk and V. P. Vovk: "Robot-Controlled Bar-Part Turning Module on a NC Machine-Tool Base"]

[Text] The single-spindle lathes with ChPU [Numerical Program Control - NC] being produced do not permit the machining of parts from bars in the automatic cycle due to their lack of mechanisms for bar-feeding and part-removal. This obstacle makes it difficult to use them in automated systems.

The devised model (diagram 1) consists of a storage loading

device--1, mounted nexted to the headstock, model 1I611PF33 machine tool --2, counter --3, automatic chuck --4, RF-202M robot --5, controllable stop with bar_sensor --6, mounted on the lateral support, robot control system --7, installed on the bed of the machine tool in place of a tailstock, receiving tray --8 with a counter of the finished parts --9 and standard packing --10.

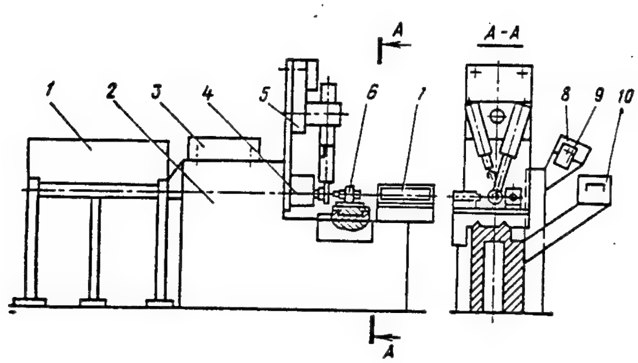

Diagram 1. Bar-Part Turning Module.

Diagram 2 shows the module's overall structure, where SChPU

[Computer Numerical Control - CNC] is the system of numerical program control of the machine tool; SU RF-202M is the robot control system, which executes: PR I - the robot control program with output of commands to the SChPU, PR II - the program controlling the loaders and counters; ZU - loaders; SchU - counter.

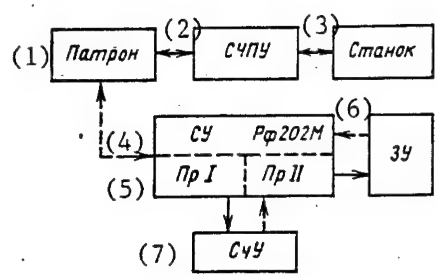

Diagram 2. Structural Diagram of the Module.

Key:

1. Chuck
2. SChPU - CNC
3. Machine Tool
4. SU 202M
5. PR I, PR II
6. ZU - loader
7. SchU - counter

Bars with a length of 1,000 mm and maximum diameter of 24 mm serve as blanks for production of parts on this module. The bar is fed in by the storage loader. The bar-input command is given by a resetable counter, in which the number of parts produced from one bar is set by means of a switch. The number of part is

$$n = \frac{1000 - l_4}{l_1 + l_2 + l_3},$$

where l_1 is the design length of the part in millimeters; l_2 is the severing allowance in millimeters; l_3 is the allowance left for facing in millimeters; l_4 is the minimal reminder of the bar allowing it to be clasped firmly in the chuck.

The module operates according to the algorithm presented in diagram 3.

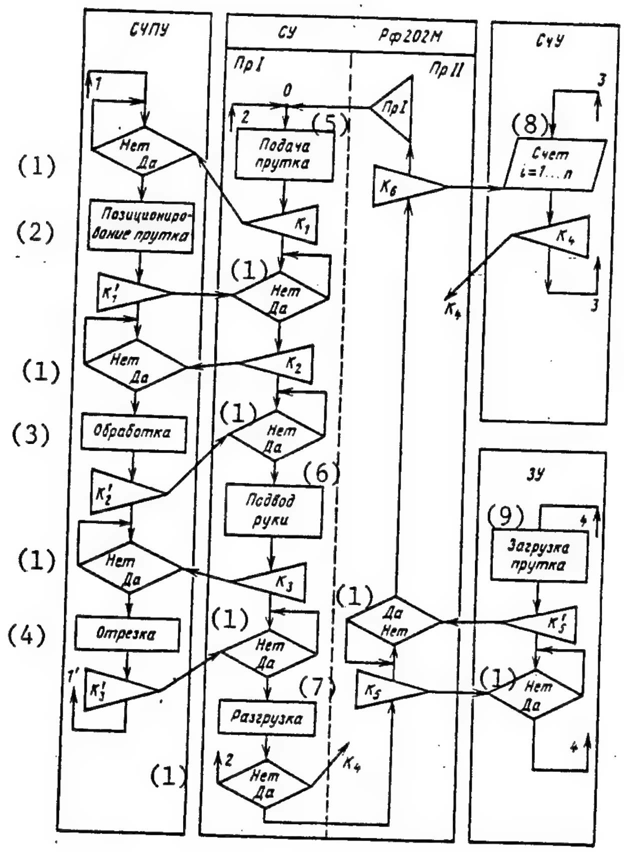

Diagram 3. Algorithm of Module Operation.

Key:

1. Yes, No.
2. Positioning of the bar
3. Machining
4. Severing
5. Bar input
6. Arm intake
7. Unloading
8. Count
9. Loading of bar

After the bar is fed to the sweep $l=l_1+l_2+l_3$ from the jaws of the chuck, the SU RF-202M issues to CNC command K_1, which starts a program to position the bar, accomplished by a controllable stop with a bar sensor.

After the program to position the bar is executed, the CNC issues command K'_1 to SU RF-202M, which gives command K_2 to CNC for execution of the part-machining program. Before severing, CNC confirms that part machining is complete by a signal K'_2 to SU RF-202M. At the command, the robot arm draws in the removing clamp which grips the blank. Then command K_3 to perform severing is given to CNC; the program directs the machine tool from CNC to cut off the finished part. After severing is completed, the robot, having received confirmation signal K'_3 from CNC, removes the part from machining position and transfer it to the receiving tray (see diagram 1), where the part is crossed by the light beam of the photoelectric pick-up and the counter counts the machined parts.

When the automatic chuck is released, the counter is interrogated by means of command K_4. If the number of machined parts does not match the target, the work cycle of the complex is repeated. If the number of machined parts equals the designated number, which is determined by formula (1), the robot control system is switched over to program PR II, which issues command K_5 for start-up of the loader, and the next bar is fed to the chuck. Having received K_5's signal confirming that the bar has been loaded from the loader, the robot control system resets the part counter by means of command K_6, whereby program PR I is executed and the complex's work cycle is repeated.

The bar is fed to sweep 1 for machining of the next part by axial movement of the robot column. Reliable feed is maintained in this process by increasing the friction coefficient between the jaws of the clamp (diagram 4, a) and the bar by filling the jaws with rubber inserts.

Finished parts with male thread are removed by using a clamp (see diagram 4, b) resembling a removable split sleeve, the diameter of which is modeled after that of the finished part.

Parts without male thread or grooves are removed by using a clamp (see diagram 4, c) resembling three freely turning rollers, between which the part is gripped just before it is cut off.

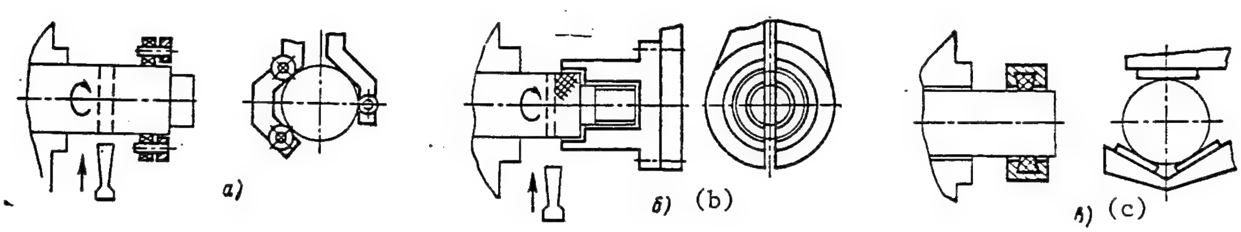

Diagram 4. Clamp Designs:
a - for bar feed; b - for removal of threaded parts; c- for removal of non-threaded parts

The automatic chuck is controlled by CNC or the SU RF-202M robot control system. When the chuck is controlled by CNC, additional commands for clamping and releasing the bar are included in the part-machining program. In this case, when the robot control system and the unit interfacing the CNC and SU RF-202M operations malfunction, the complex's robot capability is maintained during manual control operations.

Technical Characteristics of the Module

Productivity, thousands of standard parts/yr	20
Reseting time for another part, minutes	20-40
Pressure of compressed air input, MPa	0.4
Greatest diameter of machined parts, mm	24
Greatest length of machined parts, mm	40

Operation of the module requires the corresponding technological preparation of production, which consists of inclusion in the part-machining program of a framework for positioning the bar before beginning the machining of the next part, and inclusion of additional sections of programs with information on execution of certain program transfers and commands controlling the automatic chuck.

The module may be used in the complex with other modules, when multi-operational machining of parts is required, i.e., as part of a complex module or automated section.

Currently, the Production Processes Automation Laboratory of the Khmel'nitskiy Engineering Institute of Routine Maintenance is testing the basic units of the module described above, and working toward production of a system to control the dimensions of machined parts in order to increase the module's performance reliability.

12421
CSO: 1823/188

REQUISITE MACHINERY, ELECTRONICS FOR FMS EVALUATED

Moscow AVTOMOBIL'NAYA PROMYSHLENNOST' in Russian No 3, Mar 84 pp 26-27

[Article by V. P. Nechayev and A. D. Chudakov, NIITavtoprom: "The Present State and Future Prospects for Developing Control Systems for Flexible Machining Systems"]

[Text] A new type of automated equipment is beginning to be widely used in domestic and foreign machine-building: flexible machining systems (FMS), which are designed to machine part lots of various volumes and nomenclatures in succession. The systems are based on numerically controlled (NC) machine tools (as a rule, with automatic tool-changing and pallet-changing or part-handling mechanisms) combined with an automated transport-storage system. Each system component retains its own control system (NC device, storage control panel, etc.) and can function independently while a computer-based central control system automatically cycles the system's interacting units. The central control system combines these units into a unified system and organizes their joint operation to fulfill the production plan and also take care of situations not provided for in the plan.

There are several such systems operating in our country. They include the automated NC machine tool shop at BelAZ, the computer-controlled NC machine tool section at GAZ and others. However, the present task is to develop standard flexible machining systems, then widely manufacture and implement them.

The first (lowest) level of automation includes direct numerical control (DNC) systems, which are called group technology in Soviet literature. Their functions comprise operation of the complex with control programs for NC machine tools, which includes: 1) accepting the control programs prepared outside of the system and organizing their centralized storage; 2) search, editing and visual (on a screen or in printed form) indication of control program texts; and 3) distribution of control programs over communications lines (except perforated tape) to NC machine tools, control-and-measuring machines and other automatic equipment. Examples of such systems are the above-mentioned GAZ complex and the automated shop at BelAZ.

On the second level of automation are control systems for automated NC machine tool sections with a centralized storage and supply system for parts and blanks. To the above are added: 1) the collection of data on the

production process and on machine tool and transport-storage system conditions and 2) the formation of corresponding reference-accounting information and transmitting it to a screen or print. An example of such a system is the complex-automated section of the Dnepropetrovsk Electric Locomotive Plant.

Finally, the third (highest) level of automation is flexible machining systems, in which the entire production process in the complex is automated. These systems have automatic production planning, prioritized resource distribution, controlled material flow through the transport-storage system, automatic transfer devices and robots. This level also features automated distribution of programs among machine tools, processing of measurement results, automated document handling and interaction between the automated production control system and adjacent and assembly departments. Such systems are, naturally, of the greatest interest since they create the basis for a "workerless technology" operating around the clock. These systems can serve as the basic units of automated shops and plants.

The fully-automated production system is a complex of programs and machines that includes: 1) serially produced control mini- and microcomputers with the necessary set of standard terminals; 2) a set of special devices, with the control-and-measuring machines, with the automated storage control panel and with other units in the section; and 3) a set of mathematical programs consisting of the overall mathematical system (the operating system) and a set of applied machine programs with the necessary operating documentation.

The task of this system are basically different from those of control systems for traditional automated lines. These differences include, first of all, the automated development of technological and plan-organization documentation for starting up production of a new lot of parts. The other basic difference is that on a traditional automated line, the part flow is determined by the equipment layout, the design of the transport devices and the line speed; in flexible systems, parts can circulate in any manner between the machines and the transport-storage devices and at various time intervals. This presents the problem of flexible addressing control. Therefore, the central control system of a flexible system can be divided into two parts. The first part is the program-machine operational control complex. It operates in real time and provides information and control interaction with the local control devices on the equipment (machine tools, the transport-storage system, the coordinate-measuring machine and etc.) during the automatic production cycle. The second part is the set of application programs, which do not operate in real time (either per event or as a background). The programs ensure the technological and organizational preparation for starting up a new lot of parts. They also form the controlling data file for the above-mentioned real-time operating control subsystem.

The basic functions of the operating control system are:

--automatically assembling a library of control programs in the long-time memory and to provide a catalog and operational access;

--processing requests from machine tools, determining the number of the necessary control program, automatically searching for it in the library and transmitting it to the corresponding NC device;

--evaluating signals from local control devices on the performance of operations and sending commands for the next operation;

--determining whether to call up blanks from storage for the machine tool and whether to remove the parts from the machine tools; developing and sending out the necessary instructions to the transport-storage system control panel;

--accepting and storing data on the conditions in different departments (the tool room, inspection stations and etc.); these data are received from external panels or special sensors;

--outputting operational data; entering and executing unplanned directional instructions;

--evaluating the flow of parts and blanks and managing the charts showing the conditions in each workplace and in the transport-storage system;

--forming and outputting reference data on the progress of production, the present status of orders, equipment conditions, etc.

The technological preparation for starting up a new part (lot) for flexible machining system with NC machine tools involves developing control programs and tool set-up charts. Therefore, a necessary part of a functionally complete centralized control system is a subsystem for automatically preparing NC machine control programs. These programs run on minicomputers which are an integral part of the flexible system. The subsystem takes part descriptions, written in Russian phrases according to special rules, and translates them into programs in ISO codes which can be transmitted to the NC devices. The subsystem also produces accompanying data files for tool set-up. At present, a system (called "TEKHTRAN SM-1") which meets the requirements for flexible machining systems has been developed for SM-1, SM-2 and SM-2M control computers.

The organizational production preparation for a flexible machining system includes the automated development of documents and data files which determine the order of assembly and interface with adjoining departments and the order in which parts pass through the machine tools in the section. Therefore, the subsystem for operation schedule planning and evaluation is as essential a part of the functionally complete centralized flexible machining system as is the subsystem for control program preparation. Such a subsystem has already been developed by ENIMS for ASV and ASK automated machining systems. The "Avtoplan" subsystem, based on SM-1, SM-2 and SM-2M minicomputers is at present the most functionally complete subsystem that has been developed.

The "Avtoplan" subsystem solves future planning problems, such as making up part lots and production schedules for them; making up order sheets for blanks which foresee future deadlines; and etc. It also solves operations planning problems, such as: schedules for loading machines and distributing parts among machines; sending out tasks for tool and tooling set-up far enough in advance of planned deadlines; and sending out tasks for executing external operations. Document exchange with adjacent departments and management personnel is automated. Operational correcting of plan data files and documents is provided in order to cope with unexpected situations (orders not in the plan, the redistribution of work place assignments in case one or several machines break down or are placed in service, etc.).

Obviously, centrally-controlled flexible machining systems can be operational at a lower level of automation, without some of the above functions. For instance, in the absence of an automated preparation system, control programs can be prepared outside the system by one of the traditional methods and then entered into the library. In the absence of automated planning, the necessary documents can be developed by the planning-dispatch personnel, then transmitted to the operator for entry into the system, etc. This makes it possible to implement a system in stages. At the same time, it must be remembered that the term flexible machining system in many cases includes designs that are very different in terms of development level and functional completeness.

Information on functional completeness and basic indices of several domestically built flexible machining control systems is given in the table.

As the table shows, new domestically built centralized control systems are based on mincomputer control.

The solution of the above tasks involves the generation of controlling actions in response to signals (service requests) from the units in the system. Therefore, the same indices can be used for evaluating and comparing these systems as are used to evaluate automated data processing systems. Such indices are, first of all, the integral and dynamic throughput of the system over a certain period. Secondly are the time indices (average system time for answering requests of a given priority and average latency before the requests are serviced), with which other time indices can be calculated (the coefficient of service delay, the coefficient of system time shortfall and etc.). Thirdly are indices of the degree of system use, including indices of system unreliability (coefficients of readiness to accept service requests, of machine loading and of forced machine down-time).

At present, the data which would give an objective qualitative evaluation of the above indices have not yet been collected. Therefore, the task is to develop advanced, fully functional, centrally controlled flexible machining systems and determine, on this basis, these or other analogous indices.

One of the basic directions of further work on flexible control systems is the development of applied programs for central minicomputers. These programs provide for the execution of the necessary functions. They also provide special devices and communication channels for interfacing central minicomputers with NC devices and other units in the flexible system. Another basic direction is the development of microprocessor-based computer control systems specifically oriented toward centralized control functions in flexible systems A third basic direction is to develop designs for organizing production and document handling in enterprises using flexible systems.

System, developer	Type of parts being machined	Central computer	Storage, search and retrieval of parts	Machine loading and unloading	Advance planning	Operations planning
(1) ASK-10, ENIMS	Housings	M6000	Automatic	Automatic	Semi-automatic	Automatic
(2) ASK-20, Ivanovskiy Large Machine Tool Building Plant imeni 50th Anniversary of the USSR	-"-	SM-2	-"-	-"-	Not Automatic	-"-
(3) ASV-20, ENIMS	Rotating parts	M6000	-"-	Semi-Automatic	Semi-Automatic	-"-
(4) Automated shop, Dnepropetrovsk Electric Locomotive Plant	-"-	M6000	-"-	-"-	-"-	-"-
(5) Machining system*, NIITavtoprom	Housings	SM-1, SM-2M	-"-	Automatic	Automatic	-"-
(6) Machining section, GAZ	Various	SM-2	Not Automatic	Not Automatic	-"-	-"-

*Full-scale version

(table continued on following page)

Compilation of forecasts/information on the progress of production	Control program preparation	Managing the control program library and editing	Distribution of control programs to the machine tools	Orders for making up tool and tooling sets	Tool set-up	Communications Communications with adjacent and assembly departments
(1) Not automatic	Automatic	Automatic	Automatic	Semi-automatic	Not Automatic	Not Automatic
(2) -"-	Not automatic	Not automatic	Not Automatic	Not Automatic	Automatic	-"-
(3) -"-	-"-	Automatic	Automatic	Semi Automatic	Not automatic	-"-
(4) -"-	-"-	-"-	-"-	Automatic	-"-	-"-
(5) Automatic	Automatic	-"-	-"-	-"-	Automatic	Semiautomatic
(6) -"-	-"-	-"-	-"-	Not Automatic	Not Automatic	-"-

12595
CSO: 1823/183

ROBOTIZED PRODUCTION CELL WITH SIX-SPINDLE TURNING CENTER

Kiev TEKHNOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 2, Feb 84 pp 22-23

[Article by Yu. V. Pettik, engineer, Ye. Sh. Besprozvannaya and V. A. Finichenko, candidates of technical sciences: "Robotized Production Cell for Manufacturing Bushings and Gear-Type Coupling Casings"]

[Text] The Donetsk Polytechnical Institute has designed a robotized production cell for manufacturing bushings and gear-type coupling casings No 1-8 (GOST 5006-55) for the Debal'tsevskiy Metallurgical Equipment Repair Plant. It consists of a conveyor-storage unit VI (see figure), a machine tool manipulator II (model SM40Ts4011), two six-spindle semiautomatic devices I and IV (model 1283S), a hopper III for finished parts, a control console VIII, a rack V with removable transporting plates and a rack VII with blanks.

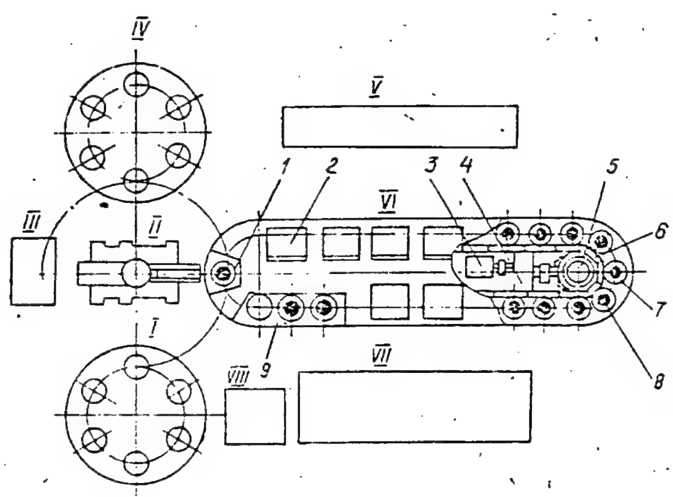

Diagram of Robotized Production Cell for Manufacturing Bushings and Gear-Type Coupling Casings

All the operations performed by the robotized production cell are combined in a control system by means of microprograms. By connecting the microprograms in the necessary sequence at the plug field, one can specify the operating mode of the manipulator and the entire cell as a whole.

The operating cycle of the cell is as follows. The instant the machining of the part on the machine tool IV is complete, a cycle start signal is fed from the control console VIII to the manipulator II. The arm-positioning mechanism is actuated and the part is removed from the machine tool with the help of a claw and is transported to the hopper III. At this time the machining of the part is completed on machine tool I. The manipulator removes it from machine tool I and feeds it to machine tool IV, first having performed a turning over operation. A start of machining signal is fed to machine tool IV and the process continues. The duration of the machining on machine tools I and IV is coordinated. During the transfer of the part from machine tool I to machine tool IV the conveyor-storage unit VI is actuated and the next blank is moved to the starting position and with the help of the arm of the manipulator II is placed on machine tool I. The machine tool engages and machining of the new part begins. The manipulator returns to the starting position.

In the event of an equipment malfunction or machine tool misalignment, an emergency subprogram switches on, audible and visual signals are sent and the cell stops.

The stability of positioning and deviation of the center line of the blank from the designated position is $\pm$ mm which is sufficient for such types of units.

The conveyor-storage unit is a chain conveyor whose power-drive station consists of an electric motor 3 and a reducer 4. Movement from the drive sprocket is transmitted to the leaf chain 6 with removable plates 7 on which the blanks 8 are placed. At unloading position 1 the part is removed from the conveyor with the help of the manipulator and is moved to the machine tool. Peepholes 2 are provided in the upper part for monitoring the operation of the conveyor-storage unit and for making minor repairs. The parts are loaded through the window 9. The design provides for pre-loading of the entire conveyor line by a worker which makes subsequent operation of the cell without human participation possible. With a output cycle duration time of 3 minutes and using 45 removable plates, the operating time of the cell in the automatic mode is 3.5 hours.

According to the work cyclogram of the robotized production cell, the total ancillary handling time is 1 minute and the machining time is 2 minutes. Consequently, in this case the output cycle time for an MZ No 3 bushing is 3 minutes.

MZ-type gear sleeve couplings are produced in 12 standard sizes according to GOST 5006-55. In this connection, changeable plates are used in the conveyor-storage unit. It is not necessary to replace them when switching to machining of other standard type couplings. In this case, the program on the machine tool manipulator is changed and a readjustment of the machine tools is made.

The cell's productivity in manufacturing MZ No 3 couplings is 20 parts per hour.

Introduction of the robotized production cell makes it possible to decrease time spent on ancillary operations to between one-fourth and one-sixth as much as now, free four people in servicing and setting-up operations of two machine tools (in double-shift operation) and obtain an annual savings of 35,000 rubles.

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IN-PROCESS CUTTING TOOL CONTROLS FOR NC LATHES

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pp 28-29

[Article by V. P. Samarkin, engineer, "Devices for Automatic Monitoring and Adjustment of Cutting Tools on Lathes"]

[Text] To increase precision, reduce the adjusting and monitoring time of the cutting tool, as well as for a more objective evaluation of its condition, lathes with NC should be equipped with an automatic adjustment and an active monitoring system.

Prototypes of devices have been developed and tested for automatic adjustment of the cutting tool in lathes. In the first model of the device an autooscillator was used as a sensor of the cutting tool position. It operates at the moment the cutting tool touches the plate which is a component of the oscillating loop of the autooscillator (the sensitive component of the sensor).

When adjusting the cutting tool by the monitoring device, distances from the monitoring components of the cutter to the sensitive components of the sensor are assigned in the control program (in the form of controlling instruction pulses). In this case, the cutter overhang may be greater than the norm, smaller than the norm or equal to it.

The signal produce by the monitoring device, when the tool touches the sensor, stops further sending to the drive of the controlling instruction pulses along the given coordinate. The information in the working memory of the NC device at the given moment is read out and is transmitted to the cells of the corrector memory. Therefore, in the third case (cutter overhang corresponds to the norm) there is no correction information in the cells. In the first case, correcting information appears in the corrector memory cell with a positive sign and the feed drive for the corresponding coordinates until the "end of program" instruction is received. In the second case, after operating for a given number of pulses for moving along a given coordinate, no touching signal is received, the instruction "end of frame" permits the introduction of additional pulses into the memory of the NC device until the touching signal appears.

The described algorithm for the operation of the active monitoring device was developed for the case of single tool machining. To use the device for multi-tool machining, it is necessary first to check and prepare every tool for operation according to an insignificantly different algorithm.

The advantages of the described method and of the monitoring device are simplicity and the small size of the sensor. However, the precision of the measurements made by this method depends on the errors of the lathe itself. When testing the device on model 16K30F305 lathe with type N22-1M NC, the measurement precision was up to 0.01 mm.

In the second model of the cutting tool monitoring device, model 223 inductive converters were used as sensors of the position of the cutting edges. The sensor unit was made in the form of an electromechanical unit made of two series inductive converters as well as nonstandard units and parts. With fairly accurate manufacturing of the electromechanical units, a measurement accuracy of 0.005 mm is obtained. The device may be used in a set with a series model 212 electronic measurement system designed to monitor dimensions of parts in the independent mode (manual mode) or with an NC unit (automatic mode).

This model is more accurate but its reliability and life are considerably less than those of the previous model. One basic shortcoming of the device when using model 223 inductive converters is its great length that makes it impossible to place it in a zone of the lathe convenient for measurement.

Investigations have shown that experimental models of the devices developed make possible the automatic adjustment and monitoring of cutting tools on lathes with NC. The first model in which an autooscillator is used as a sensor is preferable because it can easily be made at any enterprise and installed on practically all series produced lathes with NC. The sensor in the second model is designed on the basis of a fairly complicated inductive converter that requires the conversion of an analog signal into a digital one for coordinating it with the NC device.

Unlike the first model, the second model of the device may also be utilized on lathes without NC, for example, in automatic lines on grinding machine tools.

The considered devices may also be utilized for direct monitoring of parts machined on machine tools with NC. For this it is necessary to change the design of their sensitive components, making them in the form of a pin.

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TARGETED USE OF MANAGEMENT AUTOMATION, ROBOTICS URGED

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[Article by L. Volchkevich, professor, doctor of technical sciences, chairman of VSNTO [All-Union Council of Scientific-Technical Societies] committee for automation and mechanization of production processes: "A Specialist's Opinion: The Paradoxes of Robotization"]

[Text] Industrial robots today are famous and people expect miracles of them. Many are sincerely convinced that if we spare no means to produce robots and introduce them everywhere possible, the growth of scientific-technical progress will be assured and at the same time such an important social problem as abolishing manual labor also will be solved. It is not so simple to convince the engineers, scientists and ministry officials that at the present moment the forcible introduction of robots in enterprises without regard to specific conditions and needs only does harm to the work of automation. We already have had lessons from such passions. Those times when the development of automated production management systems (ASUP) was declared almost as a panacea for all production troubles and difficulties still are fresh in memory. This led to a situation where it was fashionable and prestigious to spend funds allotted for new technology primarily for ASUP. And so many enterprises rushed to create something "ASUP-like" for themselves.

There is no argument that ASUP's unquestionably are promising. They provide the opportunity to monitor the production process precisely and promptly and to calculate and analyze technical and economic indicators effectively. But this opportunity becomes reality only where production technology and means achieve a high level of perfection. In those instances where an attempt was made to use ASUP at enterprises outfitted with obsolete equipment, the automatic systems did not provide the expected effect. Often people simply didn't know what to do with them. It turned out that it was irrational and inexpedient to automatically control those who continued to work manually under poor production conditions and standards.

The hullabaloo raised over ASUP in the final account did double damage: not only aimlessly spent funds, but also delays in development of a given promising direction after the raptures were replaced by the inevitable disappointment. It got to the point where the very title of ASUP practically disappeared from use.

Something of the sort is being repeated now with industrial robots. A number of circumstances contributed to their rapid take-off, and above all the sharp aggravation of the problems of a shortage of worker cadres and especially manual labor's growing lack of prestige. The fairytale that these problems can be solved by replacing people with robots having powerful grips, an electronic brain and unlimited capabilities for perfection was grabbed up instantaneously. Moreover, robots don't drink, they don't absent themselves from work and they don't require housing or places in kindergartens. They began to be "procreated" very quickly.

Forgotten were not only the lessons of ASUP, but also the enormous experience in automating mass production, where a radical improvement in the level of labor productivity was achieved through the comprehensive transformation of production technology and equipment. Thousands on thousands of automatic manipulators which for many years now have been functioning as part of flow lines and automatic lines were merely necessary components of these systems. They accomplished no revolution in themselves.

...The Kaunas Radio Plant's automatic line for applying galvanic coatings: robots carry suspensions or drums with articles from vat to vat, providing a specific route and a production time for each of the operations. There has been an improvement both in product quality and line productivity compared with ordinary "galvanics" with manual or mechanized servicing: the first through stabilization of production conditions and the second through an increase in weight of a batch and speed of the mechanisms. At the same time a reduction in manual labor was achieved: the human was completely removed from the toxic work zone. Here robotics provided a high economic and social effect.

But here is an example of a different sort: the Zaporozhye Motor Vehicle Plant's multiposition standard-unit semiautomatic machine tool section. A robot picks up parts from a magazine device and places them in an industrial device in a loading position and at the completion of processing removes them and takes them out of the work zone. Just what is the effect? There is no improvement in product quality since robotics concerned only ancillary processes. There is also no gain in productivity since the loading-removal time in both cases coincides with the processing. Perhaps there has been a reduction in manual servicing and the number of workers in the section? Again no. Previously the worker-operator took each blank from a box and placed it in the device while performing a number of other operations in passing. Now he takes each blank from the same box and only inserts it first in the feeder, and only then the robot carries it to the industrial device. All other functions as well as the exchange and alignment of tools, adjustment and readjustment are done by a person as before. Moreover, it has become more difficult to work since the operator's place is occupied by a floor robot and the feeder loading device.

For what reason were the efforts, funds and time spent, the difficulties overcome and the inconveniences created? First of all, to report to the ministry that we have introduced robots (without, it is true, pondering why). Secondly,

to show ourselves as people who understand the importance of accelerating scientific-technical progress.

A substitution of the means for the end is taking place. Instead of struggling to improve product quality always and everywhere, to reduce production cost and cut the total number of people engaged in production by using for this purpose those methods and means which are most effective under the given conditions, we at times engage in self-deception. We try to manufacture or obtain more "fashionable" equipment in the hope that it will provide us with everything further in itself. It is as if any machine tool with ChPU [numerical program control] will replace 2-3 universal machine tools for us without fail and any industrial robot invariably will free two or three or even five persons in the shop and any EVM [electronic computer] will magically improve production conditions and standards. This contradicts not only scientific principles of technical policy, but also elementary dialectics. And so it turns out that the most progressive and promising equipment not used where, how or when it is necessary for production as a result provides neither a technical, an economic or a social effect.

What do I propose?

Above all, a rejection of the approach to robots only from the standpoint of simulating or substituting for certain human actions. Every serious application of robots must be preceded by a thorough technical and economic analysis under specific given conditions for all basic production indicators (quality, productivity, total number of workers, production cost, effectiveness of capital inputs and so on).

We should remember the experience involving introduction of machine tools with ChPU which people also initially tried to "snatch up" item by item regardless of the level of technology and production conditions and standards. Convinced of the flawed nature of such a practice, people shifted to their priority concentration as part of comprehensive sections and even shops, with the creation of appropriate engineering services. Now too it obviously makes sense to reject the "general" robotization of all enterprises and the forced allotment of their use from above. It would make sense to reorient the work of organizations in robot engineering, which today render an account only for the item by item manufacture of robots. It would be well to interest these organizations economically in the end results of production using robot engineering (quality, productivity, production cost).

These are the organizations which must become lead organizations in incorporating robots into industrial systems of machines including the development of necessary associated devices (loading, orientation, interlocking) right down to the waste removal system. I repeat that there must be an evaluation of their work not by the number of "head" of robots but by the end result of production--an improvement in product quality, an increase in the scope of its production, a reduction in the total number of workers, and a drop in production cost. Then robotization for the sake of robotization will disappear on its own and more effective incentives will appear for perfecting the parameters of robots themselves.

That is the way the necessary experience will be gained in comprehensive automation with the use of industrial robots, with minimal or even no economic losses. Only in this way will industrial robots be able to bear out our hopes.

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